



Breeding Habits of *Callosamia promethea*.

During the spring of 1876, I carefully observed many specimens of *C. promethea*, confined in boxes, with the hope of gaining some clue to the singular attracting power possessed by the females. The results were of the most unsatisfactory nature. Males confined in the same box with females seemed to be entirely unconscious of their presence, crawling over their wings, and fluttering around the box in evident bewilderment. At the same time, twenty or thirty males were collected just outside the window, attracted from great distances by the same females. Neither confinement nor fright prevented copulation, for when a male accidentally alighted on the body of a female, copulation took place, and a pair would copulate if held together in the fingers.

Only one observation of importance was made. The newly hatched female, during the first two or three afternoons, protrudes from the end of her abdomen the organ which subsequently answers the purpose of an ovipositor. At this time its delicate walls are distended by a transparent fluid, and it has the appearance of an irregularly conical sack about five or six mm. long. At intervals it is withdrawn and again protruded. The slightest jar or touch causes its withdrawal for several minutes. It is only protruded during those hours of the day when the males are active.

In the April numero of the *American Naturalist* for 1877, Mr. L. Trouvelot gives the details of experiments which prove that the males of *C. promethea*, deprived of their antennæ, are incapable of fertilizing the female, although apparently not in the least crippled by the amputation. This fact, with the one previously mentioned, served as a guide for further observations.

If a female, with ovipositor distended, be placed in a room with an open window through which there is no draught of air, although there is a slight breeze out of doors, the males will collect in great numbers, flying about the window, or even into it and about the room, but being unable to find the female, though passing close to her. The conditions are the same as when the insects are confined in boxes. Now if she is suspended

in the current of air outside the window, it will be found that the males have no difficulty in locating her. The instant that one passes to the leeward, he turns in his flight and begins working against the wind directly toward her. I have also observed that if a female alights upon the ground and then flies away, males will congregate for a short time around the spot where she had been. They show the greatest agitation, fluttering around, and grasping at different objects with their claspers.

From these facts it would appear that the female attracts the male by a volatile exhalation, and that this, acting on the nerves of the male, produces sexual desire, and prompts him to fly against the wind.

That this volatile exhalation is principally from the ovipositor is evident from the fact that this organ is only distended at those times when the males are active and the females willing. It is not distended to facilitate copulation, for the instant that the female feels the slightest touch from the approaching male it is withdrawn, the horny ring surrounding its base is protruded, the abdomen contracts and becomes rigid, particularly on the ventral surface, thus drawing the genitals downward and forward; then she is ready for copulation. That the exhalation is not wholly from the ovipositor would appear from the fact that sterile females, three or four days old, in whom this organ is dried and shrunken, and only protruded for the purpose of laying eggs, still have the attractive power. They resist every approach of the males, beating them off with their wings, and struggling to escape, but, if held fast in the fingers, the males will succeed in copulating. These females are unable to fly any great distance, in fact are quite abortive, and in the natural order of things would not exist.

The experiments of Mr. Trouvelot have proved that the antennæ of the male are necessary for the recognition of the female. Observation will show in what manner. When he is not in a state of repose, his antennæ are in constant vibration, moving back and forth in the direction of their broadest faces. This motion is very noticeable as he hovers just to the leeward of the female that he is approaching. This vibration of the

antennæ, causing a constant movement of air between their finest pectinations, would facilitate the action of no known sense except the sense of smell.

If then the male is sexually excited and guided to his mate by a sense of smell located in the antennæ, the final act of copulation must be effected by some other sense, as these organs are never directly applied to the genitals of the female. This is the case. The male lights upon the female's body, and gropes around with his claspers, until he discovers the projecting horny ring fitted for his grasp. A sexually excited male will endeavor to copulate with a dead female, another male, or even a piece of cotton twisted into the shape of the body. In this last experiment every precaution was taken to prevent the faintest smell of the female about the cotton.

If the previous conclusions are correct, it would logically follow that an insect so intensely sexually excited as a male *C. promethea* would retain the excitement for a short time after the sensation causing the excitement had ceased. The nerve centres would remain in the condition produced by the action of the volatile substance on the nerves of the antennæ after the smell itself had stopped. In fact, he should strive to effect copulation even after the antennæ are removed. As a conclusion to this season's investigations, I put this deduction to an experimental test. An attractive female was held by the wings in the open air. A male soon approached. As he alighted on her body he was caught, the antennæ were removed, and he was instantly replaced in his former position. Immediately he began groping around with his claspers, and soon copulated. After a few seconds, no longer feeling the stimulus through his antennæ, he lost his desire, loosed his hold, and, after again feeling around with his claspers, flew away, apparently as well as ever. To make sure that the fault was not with the female, I allowed the next male who approached to copulate, and he was perfectly successful.

From these observations it seems fair to conclude that the virgin female exhales a volatile substance, which, acting on the antennæ of the male, produces sexual desire, and prompts him to fly against the wind; that this exhalation is principally from

the ovipositor, and that the final act of copulation is effected by the sense of touch.

C. E. Webster.

Eristalis tenax Linn. in America.

Baron Osten Sacken, in his Catalogue of Syrphidae (Bull. Buff. Soc. Nat. Sci.), records the capture of a specimen of this fine fly, so common in Europe, in his room at Cambridge, Nov. 1875. Dr. Hagen has lately called my attention to the species, having taken several specimens the present autumn in Cambridge. During the past few weeks I have taken many specimens of both sexes in Boston and Beverly, and Mr. S. Henshaw has done the same in this vicinity. I have also in my collection two females and a male from Beverly, taken in October 1875, and among the Diptera collected in Georgia by Mr. H. K. Morrison is a somewhat soiled female, which seems to belong to the same species. We must therefore regard *E. tenax* as fairly settled in America.

The species may be recognized from its large size, 15–16 mm. in length, wing 13 mm. long. Face grayish yellow, the cheeks and a broad median stripe black; forehead and occiput black with a grayish spot and hairs between. Antennæ dark brown. Eyes with two darker stripes, connected above and below. Thorax clothed with dull tawny hair, a faint trace of pattern showing through. Scutellum brownish yellow, transparent. Abdomen black, sparsely clothed with fine yellowish white hair. Second segment with two triangular, more or less distinct, ferruginous spots. Third segment in the male with a faint trace of similar marking. The segments are margined with a row of short yellow hairs. Wings clear, somewhat embrowned on the forward margin, and sometimes slightly clouded on the disk. Legs black, knees and anterior metatarsi yellow; hind tibiæ much curved and strongly ciliated.

Edward Burgess.

[It is remarkable how rapidly *E. tenax* has spread over this part of the country. The specimen taken by Baron Osten Sacken, mentioned above, is preserved in the collection of the Museum of Comparative Zoology, and bears date of 5 Nov. 1875. There are also in the same collection two specimens of this species taken by Baron Osten Sacken, labelled Newport, R. I., 22 Oct., and 20 Nov. 1876. I have in my collection, besides many taken this season, a male taken 3 Nov. 1876, at Cambridge, Mass., and other collectors have also taken specimens.

G. D.]